Off-line Generation of ^{233}Pa and the ^{227}Pa Yield Through SISAK

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During the experiment described in the previous article we were able to determine the production cross section for ^{224}Pa by bombarding a ^{209}Bi target with ^{18}O at 88 MeV and looking for subsequent fusion product alpha decays with our MG system[1]. This is the same reaction and energy that was used to produce Pa for the SISAK extraction. SISAK is an automated system for doing ultra-fast chemical extractions. By looking at time-correlated alpha decays from the ^{224}Pa daughters ^{220}Ac and ^{216}Fr, the cross section was determined to be 0.5 ± 0.1 mb. Also during this experiment, a more precise half-life - 850 ± 20 ms - was determined than was previously available. Based on this cross section, the chemical yield of Pa through SISAK 3 was very low. Taking into account the reported cross section[2] of ^{261}Ha, the amount of this element that we should have seen would have been vanishingly small.

Calculating from the cross-section for ^{224}Pa, we should have seen about 26,000 atoms of ^{224}Pa if we had 100% chemical yield. Assuming every alpha higher in energy than ^{224}Pa that correlated with ^{224}Pa within 26 ms to be evidence for its alpha decay, resulted in 650 ^{224}Pa atoms through the SISAK system during the 40 minute experiment. This gives a yield through SISAK of only about 2.5%.

The lost Pa could be accounted for by sorption on SISAK/LISSY surfaces. To look at its sorption behavior, ^{233}Pa was generated off-line (see Fig. 1) from the decay of ^{237}Np by elution of 27 day ^{233}Pa from an anion-exchange column. The ^{233}Pa was eluted from the column with 12M HCl/0.1M HF. This Pa was then applied to samples of the materials used in the SISAK experiment to determine if Pa would strongly sorb on components of the experimental apparatus. 10 to 50 µL aliquots of this solution were evaporated directly on a glass slide, Teflon square, and Ti foil, respectively (the surface area covered was about 1 cm^2). These were then dried under a warm heat lamp - so as not to boil the solution - and washed five times with 50 µL of 1M α-HIB. After the samples were allowed to dry, the samples and the 250 µL of wash solution were counted for γ activity with an HPGe spectrometer. Pa was found to sorb very strongly to Ti, and to a lesser extent on Teflon and glass. The following results should be considered only preliminary because each material was tested only once. Similar experiments should be conducted for the organic solution for complete characterization.

Material	% Pa per cm^2
Teflon	1 ± 1
Glass	4 ± 1
Ti	18 ± 2

It seems likely that the group 5 elements Pa and Ha (element 105) sorb so strongly on Ti that we were unable to observe them.

Footnotes and References

1. D. C. Hoffman *et al*., Phys. Rev. C **41**, 631 (1990).
2. A. Ghiorso, M. Nurmia, K. Eskola, P. Eskola, Phys. Rev. C **4**, 1850 (1971).

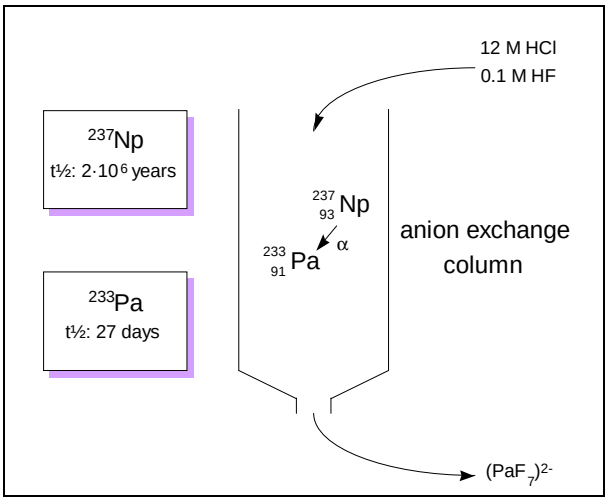

Fig. 1. ^{233}Pa Generator